OPERATION MANUAL
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EG&G 549
MICROFLASH® SYSTEM

EG&G ELECTRO-OPTICS
35 CONGRESS STREET SALEM, MASS. 01970
TEL: (617) 745-3200 TWX: 710-347-6741

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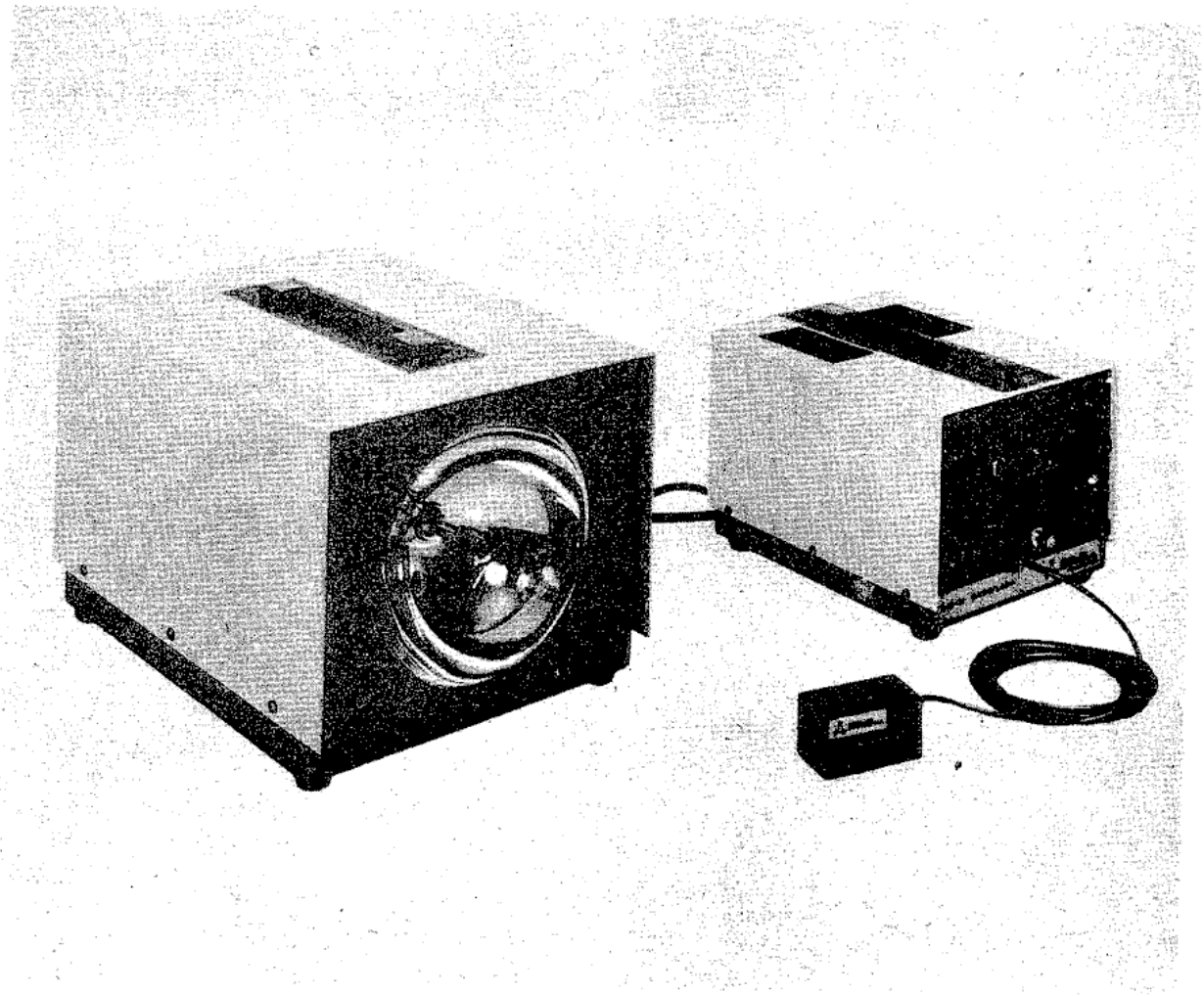

EG&G 549 Microflash® System.

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The EG&G 549 Microflash® System (frontispiece) is a small, portable light source for ultrafast stop-motion photography. Its high peak light output and very-short flash duration make it singularly useful in photographing bullets in flight, spalling particles, fragmenting materials, parts of high-speed machines, and other nonluminous, high-velocity subjects. The compact, functional-unit design and operational simplicity permit use in a variety of research and industrial applications.

Figure 1 shows a .30-cal bullet travelling at 2800 feet per second stopped-in-flight by the Microflash® System. Note that the bullet and the particles of card are completely stopped and sharply defined. Figure 2 shows balloons frozen in the act of exploding after being hit by a bullet. Most conventional strobes in use today have a flash duration approximately 1000 times longer than the 549 Microflash® System and photographs of bullets and other fast moving subjects are usually blurred.

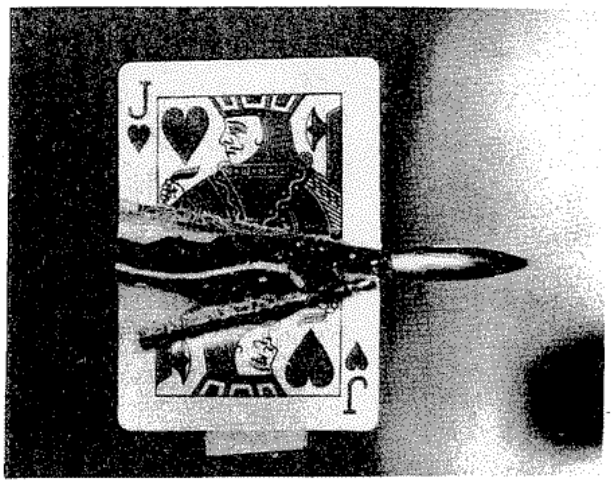


Fig. 1. Bullet stopped-in-flight after cutting playing card.

1.1 SPECIFICATIONS

Flash Duration	0.5 microsecond
Peak Light	50×10^6 beam candlepower

Fig. 2. Balloons after being hit by bullet are frozen by high-speed photography.

Light Quality	Approximates daylight
Energy Input	6.5 watt-seconds (0.05 μf at 16 kv)
Time Delay	Adjustable—approximately 3 to 1000 microseconds, uncalibrated
Recycle Time	5 seconds
Input Voltage	115 volts, 50-60 cps
Size - Flash Unit	16 in. x 10 in. x 8-1/2 in.
- Driver Unit	9-1/2 in. x 7-3/4 in. x 6-1/2 in.
Weight - Flash Unit	16 pounds
- Driver Unit	12 pounds (including Microphone)

1.2 DESCRIPTION

The 549 Microflash® System has two basic components, the Model 549-11 Flash Unit and the Model 549-21 Driver Unit. A Model 549-21-11 Microphone is also supplied as part of the basic system. Accessories available for special applications are described in Appendix A.

1.2.1 Model 549-11 Flash Unit

The Flash Unit houses the air flashtube (guided spark-gap light source*) and reflector, the rectifier circuit, energy-storage capacitors, and trigger transformer. The sole operating control is a single (ON-OFF switch (with indicator lamp) on the rear panel of the housing (all other Microflash® System operating controls are located on the front panel of the Driver Unit). For added convenience, a standard 1/4-20 tripod socket has been included in the base of the housing cabinet. The entire reflector assembly of the unit can be detached by removing two retaining screws on the front panel.

The unit operates from 115 volts ac, 50 to 60 cps, and has a permanently-attached, three-conductor power cable, one conductor of which is grounded to the unit's frame. The three-pronged connector plug of the cable is commonly connected to a power receptacle on the rear panel of the Driver Unit, but it may also be connected directly to a main power outlet, if desired. The grounded conductor arrangement ensures safe, ground-potential operation when the Microflash® System is connected to a grounded a-c outlet.

1.2.2 Model 549-21 Driver Unit

The Driver Unit houses two small power supplies, a photoelectric tube, and two thyratron tubes and associated circuitry. This unit generates a 2-kv trigger pulse for application to the trigger transformer of the Flash Unit.

Operating controls on the front panel of the unit permit varying of the trigger sensitivity, the time delay, and the method of triggering. By means of the built-in photoelectric tube or the Model 549-21-11 Microphone, the Driver Unit can be triggered by either light or sound. In addition, a MANUAL pushbutton permits triggering by simple contact closure. The Microphone receptacle can also be used to insert a low-voltage positive trigger signal from an external source.

*Edgerton, H., Tredwell, J., and Cooper, Jr. K., "Submicrosecond Flash Sources", SMPTE Journal, 70, March 1961, 177-180.

The unit operates from a source of 115 volt a-c, 50 to 60-cps power, and has a permanently-attached, three-conductor power cable, similar to that of the Flash Unit, for safe, ground-potential operation when connected to a grounded outlet. It also has a connector for the Flash Unit power connection, permitting both units to be operated from a single power outlet, and turned on or off by a single switch.

1.2.3 Other Basic System Assemblies

An eight-foot length of shielded three-conductor Belden cable conveys the trigger signal generated by the Driver Unit to the Flash Unit. When the Model 549-21-11 Microphone is used to trigger the Microflash® System, its attached cable is plugged into a receptacle on the Driver Unit front panel.

Ultrafast stop-motion photography with the 549 Microflash® System is not difficult and does not require complicated or expensive setups. The system is, in fact, simpler to use and much more flexible in application than the more conventional strobe equipments in common use today. The subjects which can be photographed and the information obtained are really limited only by the imagination and ingenuity of the user, not by the Microflash® System. A typical setup for ballistic photography will illustrate the simplicity and versatility of the system and suggest ways of applying these procedures to other high-speed photographic measurements.

2.1 BALLISTIC PHOTOGRAPHY

Figure 3 illustrates a typical arrangement for bullet photography.

CAUTION

The Microflash® System should be given a three-minute warm-up before operation to ensure that the thyratron cathodes are at operating temperature before the unit is fired. The SENSITIVITY control should be left on

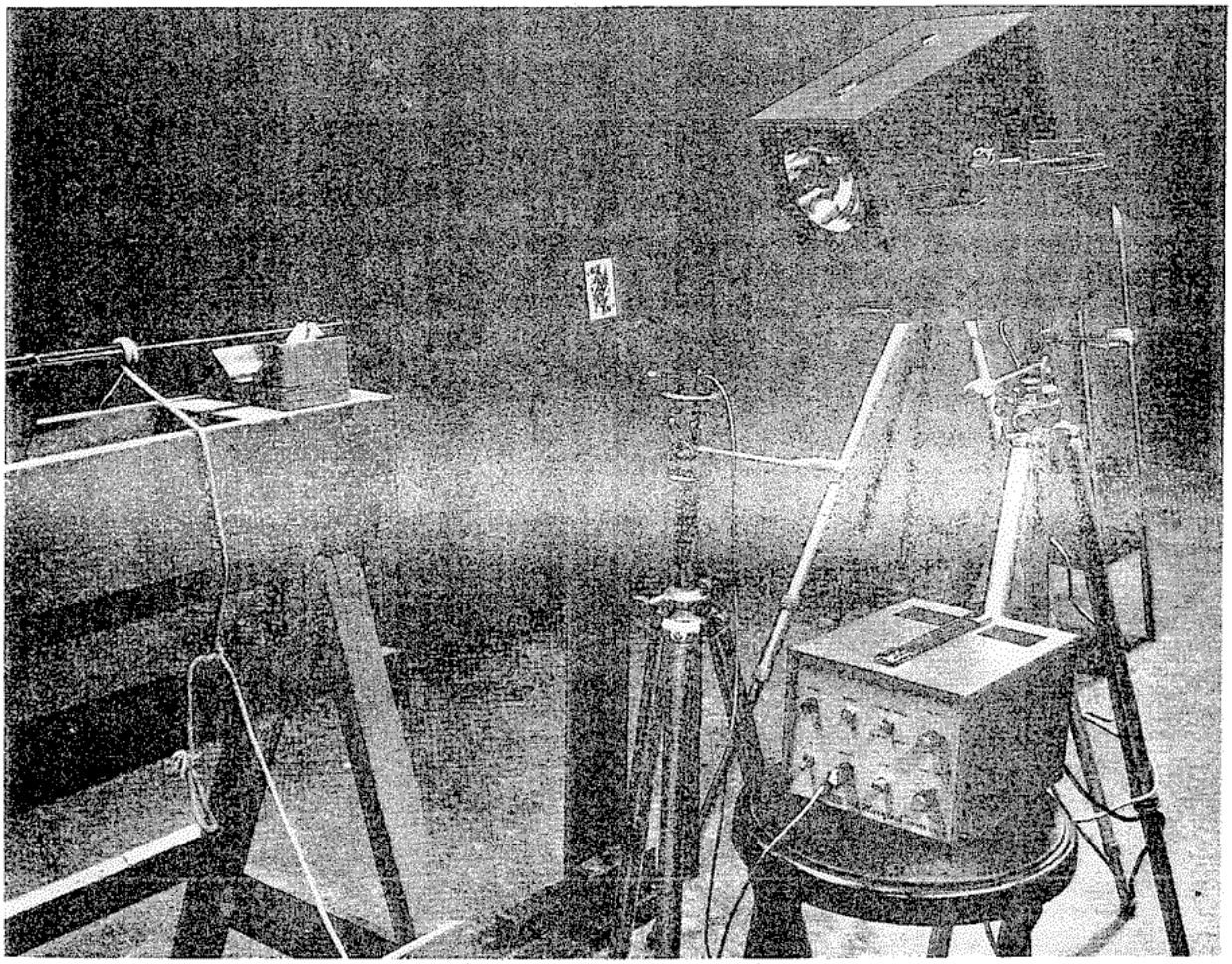


Fig. 3. Typical arrangement for bullet photography.

the zero position to prevent the unit being fired during the warm-up period.

To ensure an invariable bull's-eye during bullet photography, the rifle should be lashed securely in the cradling stand and the whole stand then sandbagged. A 6-inch diameter, 2-foot long bullet catcher (a steel pipe filled with sand) may be used for the target.

When the rifle has been zeroed in, the Flash Unit must be positioned so that it will illuminate the bullet as it travels through the field of view of the camera. With both the Flash and Driver Units connected and energized (see paragraph 1.2 and the schematic diagrams for connections), the correct position of the image of the bullet on the ground glass can be obtained by practice firing during which the Microphone is moved to different positions parallel to the trajectory of the bullet. Moving the Microphone farther from the muzzle will cause the light to flash later, when the bullet is farther from the muzzle.

NOTE

Paragraph 2.4 provides additional data on audio (microphone) and other triggering methods.

In general, when the flash-to-subject distance is between two and four feet, bullet photographs can be taken at f/11 on black-and-white film that has an ASA rating of 100. With a white background and reflector, it is possible to take photographs at smaller aperture settings or to use slower, fine grain films. (A white background is recommended for bullet photography to silhouette the dark edge of the subject.)

When triggering of the flash is controlled by the Microphone (or photocell, contactor, or similar trigger signal), it will be most convenient to leave the camera shutter open and work in a darkened room.

In processing, films may be given increased development (50% or more) to compensate for the inherent loss of contrast which seems to occur when short-duration flashes of predominantly blue light are used (see Fig. 4).

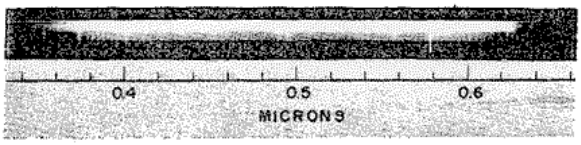


Fig. 4. Light spectrum, 549 Microflash System.

Excellent color photographs can be obtained using the Microflash® System and a camera loaded with daylight-type color film. With High-Speed Ektachrome film, a lamp-to-subject distance of two to four feet and an aperture of f/8 give a satisfactory exposure for light-colored subjects. (A CC50Y blue-absorbing filter can often be used to correct color photographs that evidence an overall bluish cast.) Other color film exposures can be determined experimentally using the High-Speed Ektachrome figure as a guide.

2.2 ADDITIONAL SETUP CONSIDERATIONS

The physical arrangement of camera,

Flash Unit, and subject will vary depending on the particular subject being photographed. Should blast or heat from the subject be a problem, a glass shield can be placed between the subject and the camera and Flash Unit. If a glass shield must be used, care should be exercised that the shield does not cause the light to be reflected back into the camera lens.

When the instant of synchronization is not critical, the camera shutter (X-contacts) can be used for synchronization.

NOTE

If room light is high enough to expose the film, the faster shutter speeds should be used.

2.3 CONTROL SETTINGS

2.3.1 Time Delay Setting

A TIME DELAY control knob on the front panel of the Driver Unit (Fig. 5) allows the user to vary the time between application of the input signal and triggering of the flash with about 20% accuracy. When the time delay toggle switch is in the 0.1 M SEC. RANGE position, the delay can be varied from 2 microseconds to 100 microseconds. In the 1.0 M SEC. RANGE position, the range of adjustment is increased to 1000 microseconds.

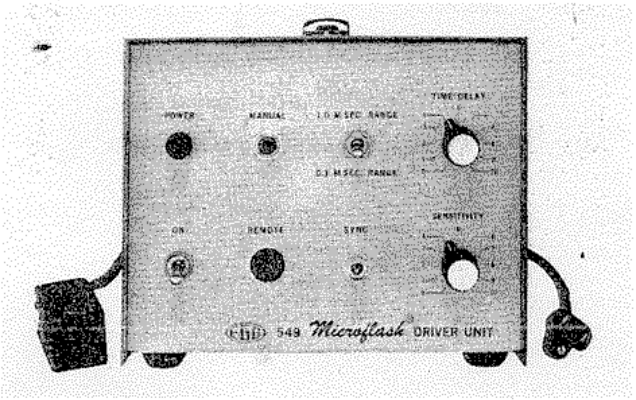


Fig. 5. Model 549-21 Driver Unit controls and indicators

NOTE

Although the trigger circuit has been designed for fast triggering (measured delay between application of the input signal to the Driver Unit and the beginning of the flash is usually about 2 microseconds), a hard starting flashtube could cause a delay of as much as 5 microseconds.

While the delay provided is not precise, it can be calibrated by conventional methods for the particular application. If the time delay is calibrated, measurement of displacement between successive photographs taken at different delay settings will provide an accurate measurement of the speed of the subject. (Time-delay calibration will vary slightly with line voltage.)

Since each 549 Microflash® System has a photoelectric tube in the Driver Unit, double exposures of a subject can conveniently be made on the same sheet of film using two complete systems. With one Flash Unit triggered in a conventional way by contactor or Microphone, the second Driver Unit can be positioned so that it is triggered by the flash from the first Flash Unit. (The snap cover at the rear of the second Driver Unit housing must be removed so that the second Driver Unit "sees"

the flash from the first Flash Unit.) The flash from the first Flash Unit will then initiate triggering of the second. If desired, a time delay can be introduced between the two flashes by advancing the TIME DELAY control knob on the second Driver Unit.

2.3.2 Sensitivity Setting

The SENSITIVITY control knob on the front panel of the Driver Unit (Fig. 5) is used to control the trigger sensitivity. By changing the bias voltage on the thyratron, the SENSITIVITY control makes it possible to trigger the unit with an appreciable range of input trigger signals. The most sensitive triggering condition for a particular input signal can be obtained by advancing the SENSITIVITY control knob to that point at which self-flash* occurs. When the self-flash position is reached, the SENSITIVITY control knob should be backed off slightly until self-flash no longer occurs. The unit is then at the most sensitive trigger setting.

2.4 TRIGGERING METHODS

2.4.1 Audio Triggering

The Model 549-21-11 Microphone supplied with the system should be used for audio triggering. When audio triggering is used, the Driver Unit SENSITIVITY control knob should be adjusted for maximum sensitivity. Although the Microphone is sensitive enough to use as an audio trigger in work with ballistics or explosives, its output may need amplification in applications where the input is of lower magnitude. Any amplification should be introduced between the microphone output and the trigger input (REMOTE receptacle connector) of the Driver Unit.

2.4.2 Light Triggering

A photoelectric tube (V102 in schematic diagram, Appendix B) in the Driver Unit can be used to trigger the unit from a flash of light. The snap cover at the rear of the Driver Unit must be removed and the unit positioned so that the photoelectric tube picks up the triggering flash. A maximum sensitivity setting should be used.

Although no provision has been incorporated for triggering by light-beam interruption, any photoelectric "magic eye" system can be used for triggering if it provides a positive voltage pulse of a few volts. This output pulse would be introduced at the REMOTE receptacle connector on the front panel of the Driver Unit.

2.4.3 Contactor Triggering

Any contact closure can be used for triggering with the SENSITIVITY control knob at some low setting. If multiple triggering should occur because of contact bounce (the fast recycling time of the unit makes this a distinct possibility), a capacitor of about 0.2 μf across the trigger input should eliminate the problem.

CAUTION

A capacitor should not be introduced with other triggering methods as it will cause an undesirable reduction in sensitivity.

*Self-flash is the sensitivity point at which the unit will trigger without application of an external trigger signal.

Triggering from contact opening (as opposed to contact closure) can be accomplished with the circuit shown in Fig. 6 introduced into the trigger input.

In addition to the contactor triggering methods listed above, the MANUAL pushbutton can be used, as can any positive electrical pulse of a few volts introduced at the trigger input terminals (REMOTE connector).

2.5 SECONDARY EQUIPMENT TRIGGERING

On the front panel of the Driver Unit, a BNC connector marked SYNC is provided for use in the event it is desired to trigger some secondary equipment after the flash. The SYNC connector supplies a positive pulse of a few hundred volts one microsecond after the input triggering pulse occurs. This pulse can be used to trigger other equipment.

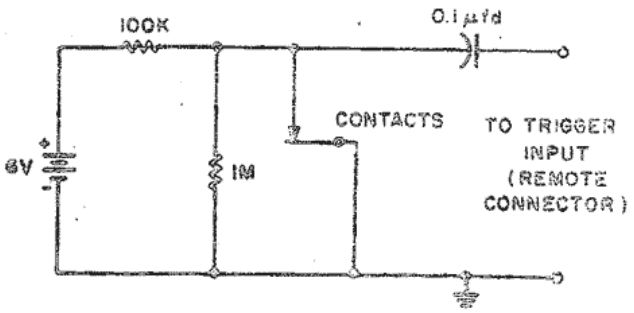


Fig. 6. External circuit for contact triggering.

2.6 REPETITION RATE

Although the Microflash® System recycles in a very brief interval, the unit should not be fired too rapidly (more than one flash per 5-second interval).

CAUTION

At excessively fast repetition rates, the violent nature of the discharge will cause fracture of the trigger - wire - insulating glass rod.

No unusual or highly complex circuits have been incorporated in the Microflash® System and no extended discussion of the principles of operation is necessary. A discussion of the air flashtube is given as a basis for understanding this light source and facilitating the replacement of certain of its parts. The principles of operation for any circuit stage not covered in point-by-point detail in this section can easily be determined from the associated schematic diagram.

3.1 FLASHTUBE PRINCIPLES OF OPERATION

In high-speed stop-motion photography, two mutually-opposed requirements must be considered: the quantity of the light (light output), and the duration of the flash. In many electronic flash devices, the light output can be increased simply by varying the capacitance of the voltage in the driver circuit to obtain a different input energy ($E = \frac{CV^2}{2}$). However, when the additional requirement of brief flash duration is introduced, the half period of the discharge, ($T = \pi\sqrt{LC}$ seconds), precludes increasing the size of the capacitor. While it would then appear that simply increasing the voltage would be the preferred method of increasing the light output while still maintaining the brief duration, there are practical limits to which this can be carried.

The EG&G 549 Microflash® System meets both the high light output and brief duration requirements by employing an air flashtube (guided-spark-gap light source).

In an air flashtube, the gap between the two discharge electrodes is sufficiently large that unaided discharge of the potential between the electrodes is not possible under normal conditions. A third (triggering) electrode is introduced between the two discharge electrodes but insulated from them by a glass rod. Since the trigger electrode is insulated from the discharge electrodes, the effective gap length is not reduced (reduction in length lessens light output).

In the air flashtube of the Microflash® System (Fig. 7), the 16-kv potential between the discharge electrodes cannot discharge across the 1-inch gap along the glass surface until a high-voltage trigger pulse (about 70 kv) is introduced on the adjacent glass-enclosed trigger electrode. The lengthened spark gap provides a higher light output and the afterglow is less than would be encountered with a smaller gap or a conventional xenon flashtube. Figure 8 is a light-time oscillogram of the peak 50-million-candlepower light flash of approximately 1/2-microsecond duration.

3.2 MODEL 549-21 DRIVER UNIT

The Model 549-21 Driver Unit (see schematic diagram, Appendix B) generates a 2-kv trigger pulse for application to the trigger transformer of the Flash Unit.

The unit is supplied 115-volt a-c, single-phase, 50 to 60-cps power through a three-conductor cable with three-pronged plug P101. One conductor of the cable is grounded to the Driver Unit frame to ensure safe, ground-potential operation when the three-pronged plug is connected to a grounded 115-volt a-c outlet. A double-pole, single-

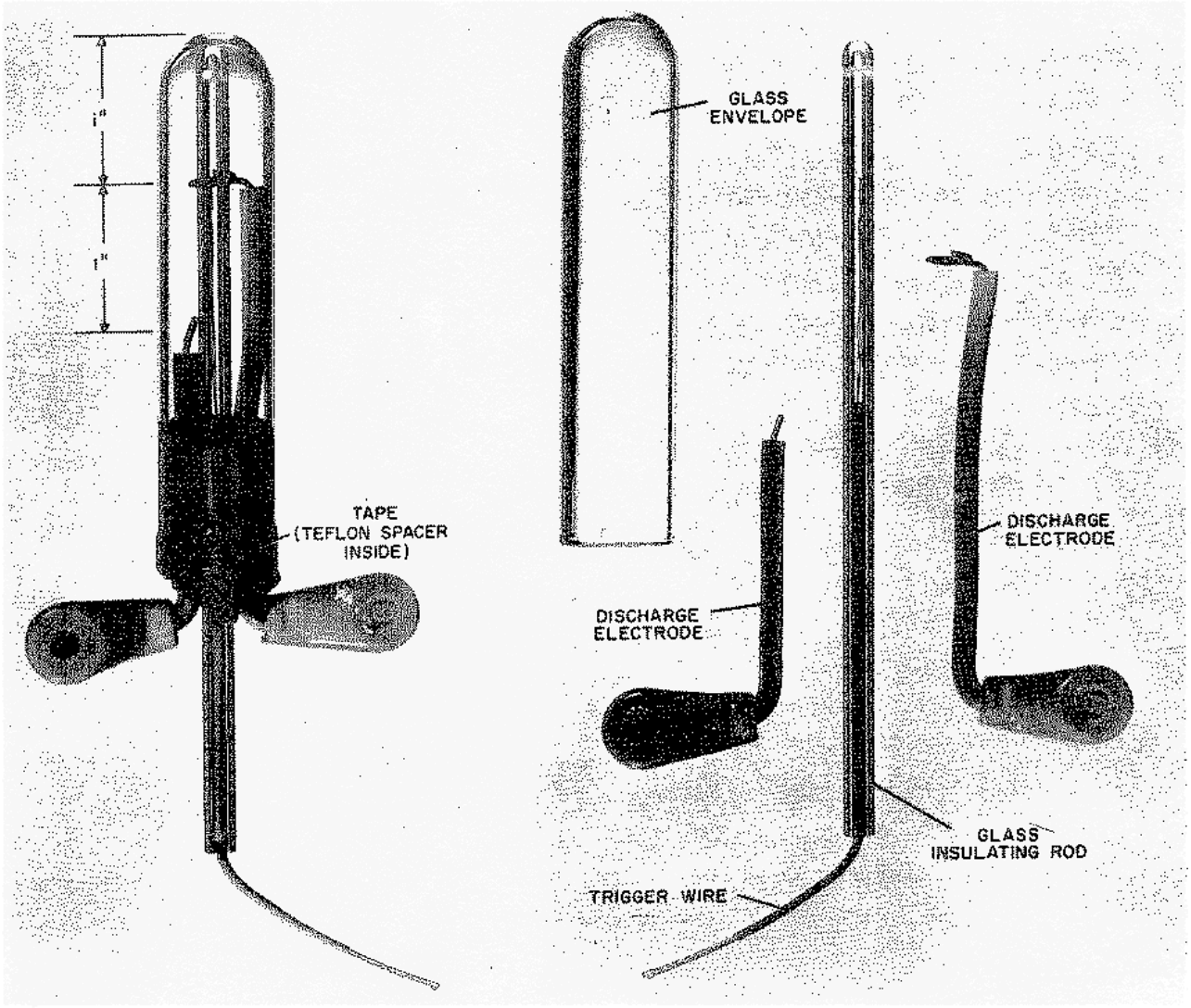


Fig. 7. Air flashtube shown assembled and disassembled.

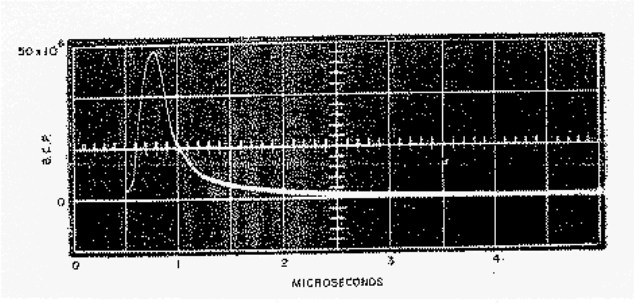


Fig. 8. 549 Microflash System light-time oscillogram.

throw ON-OFF switch S101 (with associated indicator lamp DS101) feeds the input power through 1/2-amp "Slo-Blo" fuse F101 to step-up transformer T101. After the input power passes the ON-OFF switch, a second power circuit in parallel feeds the 115 vac to three-pronged receptacle connector J101 on the rear panel of the Driver Unit. This is the connector to which the three-pronged power plug from the Flash Unit connects,

and this configuration makes it possible to turn power to both units on or off by means of the single switch S101.

Diode V101 across the secondary of the step-up transformer serves as a conventional half-wave rectifier and the power supply provides approximately a +2 kv d-c output to the plate circuit of krytron V104. Three 2.2-megohm resistors R102, R103, R104 are connected as a voltage divider to provide a second output of approximately +650 volts d-c to photocell tube V102 and thyratron V103.

An additional connection to the 115-volt a-c input power, in parallel with the above, feeds to a second power supply consisting of transformer T102 and associated circuit elements, which supplies filament voltages to the two thyratrons and a negative grid bias voltage for thyratron V103. By means of SENSITIVITY potentiometer R113 in this supply, the bias voltage on the thyratron can be changed as desired to adjust its triggering sensitivity to a range of trigger input signals.

Thyratron V103 can be triggered by any of several means which serve to make the bias voltage less negative. Normally the grid is at some negative voltage up to approximately -8.5 volts, depending on the setting of the SENSITIVITY potentiometer. If the MANUAL pushbutton is depressed to trigger the Flash Unit, the grid voltage is momentarily brought up to approximately zero volts as a positive-going spike, as the negative potential formerly across switch S102 begins to build up across the adjacent 0.01 μf capacitor C104. This is sufficient to cause the discharge of the 0.5 μf energy-storage capacitor C102 through thyratron V103, charging the 0.0005 μf and 0.035 μf capacitors C106 and C107 at a rate determined by the setting of TIME DELAY potentiometer R110. If time delay range switch S103 is set in the 1.0 M SEC. RANGE position, the 0.22 μf capacitor C108 is also charged, and the limit of the time delay possible is increased from 100 microseconds maximum to 1000 microseconds maximum.

As the voltage on the grid of krytron V104 becomes more positive, this tube is also triggered and its associated 0.05 μf capacitor C109 discharges. The 2-kv negative-going output pulse is fed to the trigger transformer of the Flash Unit through pins 14 and 16 of connector J104 and an 8-foot length of three-conductor, shielded Belden cable.

Thyratron V103 can also be triggered by a positive pulse from photoelectric tube V102 through the associated 0.001 μf coupling capacitor C103 when the photoelectric tube is made to conduct through exposure to a source of light. Application of a triggering pulse a few volts positive from a microphone or other external source is made through connector J102.

3.3 MODEL 549-11 FLASH UNIT

The Model 549-11 Flash Unit (see schematic diagram, Appendix B) develops the voltages necessary to fire the air flashtube. (Flashtube principles of operation are described in paragraph 3.1.)

The Flash Unit receives 115-volt a-c,

single-phase, 50 to 60-cps input power through a three-conductor cable with three-pronged plug P201 which is normally connected to power receptacle connector J101 on the rear panel of the Driver Unit. (The power cord can also be connected directly to the main a-c outlet, if desired.) One conductor of the power cable is grounded to the Flash Unit frame for safe, ground-potential operation in the same manner as the power connection to the Driver Unit.

The a-c input power is fed through dpst ON-OFF switch S201 (with associated indicator lamp DS201) and 1/2-amp fuse F201 to step-up transformer T201. A full-wave voltage doubler CR201-CR206, C201, C202 at the secondary of the transformer develops +8 kv and -8 kv d-c potentials on the two discharge electrodes of the air flash-tube. The 0.1 μf energy-storage capacitors C201, C202 connected between each potential and ground provide a total capacitance of 0.05 μf. The 100-megohm resistors R201, R202 in parallel with each capacitor allow the charges to bleed off the capacitors after power is removed from the unit.

The trigger pulse from the Driver Unit is stepped up as a high-voltage spike (about 70 kv) by trigger transformer T202 and introduced on the glass-enclosed trigger electrode to discharge the potential between the other two electrodes.

The Microflash® System components require no lubrication or other regular maintenance except occasional routine inspection for signs of damaged or otherwise defective parts. Inspect for burned-out indicator lamps, broken caps, loose control knobs or switches, loose tubes, damaged connectors, and cracked, frayed, or worn insulation on leads or interconnecting cabling. Inspect for charring, melting, or any other obvious signs of overheating which could be a potential source of trouble.

4.1 TROUBLESHOOTING AND CORRECTIVE MAINTENANCE

During the operating life of the Microflash® System, an occasional malfunction may be encountered because of improper operation, faulty interconnection, or simple component end-of-life. Should a malfunction occur, the nature of the failure will often suggest both the probable cause and necessary corrective action.

NOTE

The violent nature of the flash from the Microflash® System, a surface discharge over a glass rod, can cause vaporization of the glass and consequent air flashtube failure. Repeated firing over short intervals of time (more than 1 flash per 5 seconds) will cause heating of the glass rod and subsequent electrical breakdown. Failures of this type will usually necessitate replacement of both the glass trigger rod and the Flash Unit fuse.

The troubleshooting information given in Table 1 which follows should be sufficient for diagnosing the majority of malfunctions which could conceivably arise.

WARNING

Before performing any corrective maintenance replacement procedures, disconnect the a-c power cabling to both the Driver Unit and Flash Unit and allow two minutes for the charge to bleed from all capacitors.

4.2 REPLACEMENT OF FLASHTUBE OR FLASHTUBE PARTS

A spare flashtube and several extra trigger-wire-insulating glass rods are supplied with each 549 Microflash® System.

WARNING

Before performing any flashtube replacement procedures, disconnect the Flash Unit a-c power and trigger connections from the Driver Unit. Then wait two minutes for the charge to bleed off from the capacitors.

Replacement of a complete flashtube assembly is a relatively simple operation.

a. Remove the two front panel retaining screws which secure the combination front panel-reflector assembly to the Flash Unit frame (see Fig. 9). Set aside the front panel-reflector assembly.

b. Study the manner in which the

Table 1. Troubleshooting Chart

Malfunction	Possible Causes	Observable Condition	Corrective Action
Flashtube fails to fire.	Fuse blown in Flash Unit.	Indicator lamp out in Flash Unit (rear of housing).	Replace fuse.
	Fuse blown in Driver Unit.	Indicator lamp out in Driver Unit (front panel).	Replace fuse.
	Flashtube faulty.	All indicator lamps lit. V104 thyratron shows glow discharge.	Replace flashtube (see paragraph 4.2).
	Faulty triggering.	Advance SENSITIVITY to just below self-flash position and repeat with MANUAL trigger.	Change trigger sensitivity.
	V104 krytron faulty.	All indicator lamps lit. No discharge on thyratron.	Replace V104 krytron.
	V103 thyratron faulty.	All indicator lamps lit. No thyratron discharge.	Replace V103 thyratron.
	V101 rectifier faulty.	All indicator lamps lit. No thyratron discharge. No high voltage in trigger circuit.	Replace V101 rectifier
	TR-50 trigger transformer faulty.	No trigger spark noise. No trigger spark when unit is observed in darkened room.	Replace transformer TR-50.
	Other component failure.	Make point-to-point circuit test (follow schematic diagrams).	Replace faulty component.
Flashtube fires without external trigger.	SENSITIVITY is too high, unit is self-flashed.	Trouble cured when SENSITIVITY control is backed off.	Use lowest sensitivity possible with type of triggering.
	Ambient noise or light level is triggering unit through sound or photo pickup used.	Trouble not evident when ambient noise or light level is reduced.	Reorient the pickup to eliminate false signals.
	Flashtube faulty.	Glass trigger rod cracked.	Replace glass trigger rod.
KN2	V104 krytron faulty.	Unit continues to flash when V103 thyratron is removed.	Replace V104 krytron
156	Flashtube dirty.	Moisture or contaminants present in tube.	Wipe tube and glass rod thoroughly.

flashtube to be replaced has been connected in the Flash Unit.

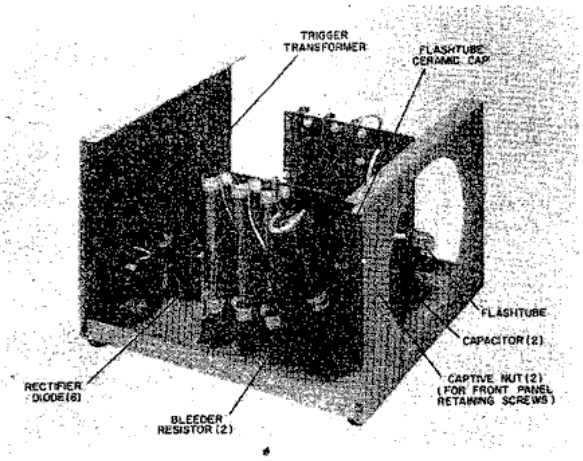


Fig. 9. Flash Unit with reflector assembly and housing removed.

c. Using a high-voltage bleeder stick which has a nonconducting handle and a 10-kilohm, 10-watt resistor, short both capacitor terminals to chassis ground as an added safety measure.

CAUTION

Do not use a screwdriver to discharge the capacitors.

d. Turn a screwdriver blade under the two white ceramic caps of the flashtube and free the caps from the capacitor terminal posts.

e. Loosen the locking screw in the corona ball and remove the flashtube trigger wire.

f. Lift out the flashtube.

g. Install a new flashtube and replace the front panel-reflector assembly by reversing the above procedures, as necessary.

If the trigger-wire-insulating glass rod should ever show evidence of fracture, the flashtube can easily be rebuilt. To rebuild a flashtube, proceed as follows (also see Fig. 7):

a. Remove the flashtube from the Flash Unit as described in steps a through f above.

b. Remove the tape from the base of the flashtube.

c. Withdraw the spacer and the three electrode elements as a subassembly.

d. Remove the tape from the electrode elements.

e. Separate the trigger wire and its glass rod from the subassembly.

f. Separate the trigger wire from the glass insulating rod.

NOTE

If the wire has been sealed in, the trigger wire can be freed by smashing the insulating rod.

g. Insert the trigger wire into a new glass rod (the same length of wire should be left exposed on the outside of the rod as was exposed on the original).

h. Carefully wipe the glass rod and trigger wire to remove moisture and any contaminants.

i. Insert the glass rod and trigger wire through the loop in the larger electrode.

j. Retape the electrode elements in

their former positions. (The bare part of the trigger wire in the glass insulating rod should be between the two discharge electrodes and the electrodes should be 1 inch apart along the rod). It is very important that the discharge electrodes touch the glass rod.

CAUTION

The longer discharge electrode should be bent away from the glass rod except for the point of contact of the loop to prevent arc crazing of the glass.

k. Wrap the spacer about the taped junction and insert the subassembly in the glass envelope.

l. Tape the glass envelope and the electrode element subassembly together and replace the rebuilt flashtube in the Flash Unit as described in the earlier procedure.

4.3 OTHER FAILURES

Should failures other than those described herein be encountered, a point-to-point circuit check by a competent electronics technician who has studied the schematic diagrams and the discussion of the principles of operation should locate the source of the trouble. Replacement of any faulty component should be made in accordance with standard electronics practices.

A. 1 549 MICROFLASH ® SYSTEM ACCESSORIES

Two accessory devices, a Model 549-11-11A Point Light Source Adapter and a Model 549-11-21 Remote Flash Head, extend the range of applications of the Microflash ® System.

The Point Light Source Adapter is a snap-on spark gap with a small (1.6-mm diameter) aperture to limit the size of the arc. With the Point Light Source Adapter, it is possible to take silhouette photographs by shadowing the subject directly on the film.

The Remote Flash Head was developed because many optical arrangements require a lamp placed at a distance from the Flash Unit.

These Microflash ® System accessory devices are described in the following pages.

A. 2 MODEL 549-11-11A POINT LIGHT SOURCE ADAPTER

Operation of the Microflash ® System as a point light source for shadowgraphy is quite simple. The Point Light Source Adapter is installed in the Flash Unit in the position normally occupied by the air flashtube (see paragraph 4.2 in this instruction manual). A cardboard shield with a small hole cut in it to allow passage of the light from the spark gap should be placed in the position normally occupied by the reflector assembly to eliminate any undesirable scattered light.

NOTE

Although increased sensitivity can be obtained with a greater subject-film distance, definition will be sacrificed since there is practically no depth of field in a shadowgraph.

As the Flash Unit is triggered by the subject, the light from the Point Light Source Adapter will cast the shadow of the subject onto the film (Fig. A-1). Some experimentation with equipment placement may be necessary before the exposure and the position of the subject image on the film are exactly as desired.

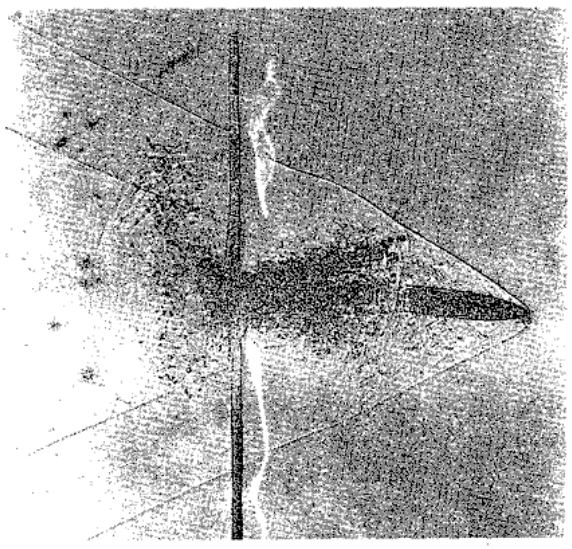


Fig. A-1. Plexiglass pierced by bullet.

A. 3 MODEL 549-11-21 REMOTE FLASH HEAD

A Remote Flash Head which can be used at a distance of about 12 inches from

the Flash Unit is also available. Essentially a standard air flashtube on an extention, the Model 549-11-21, can be used for making shadow photographs of subjects that occupy a large area. The Remote Flash Head is simply plugged-in in the position normally occupied by the air flashtube.

The following shadow photograph of a pistol discharge (Fig. A-2) was taken with the Microflash System equipped with the Remote Flash Head. The accompanying sketch (Fig. A-3) shows the physical arrangement used.

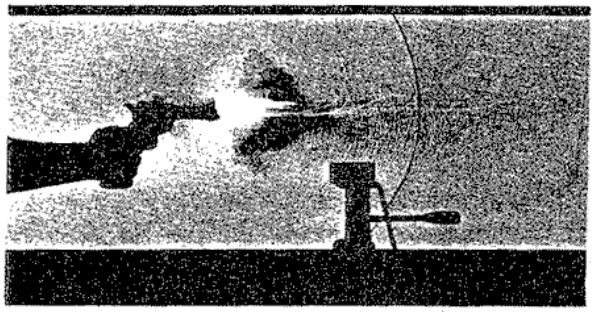
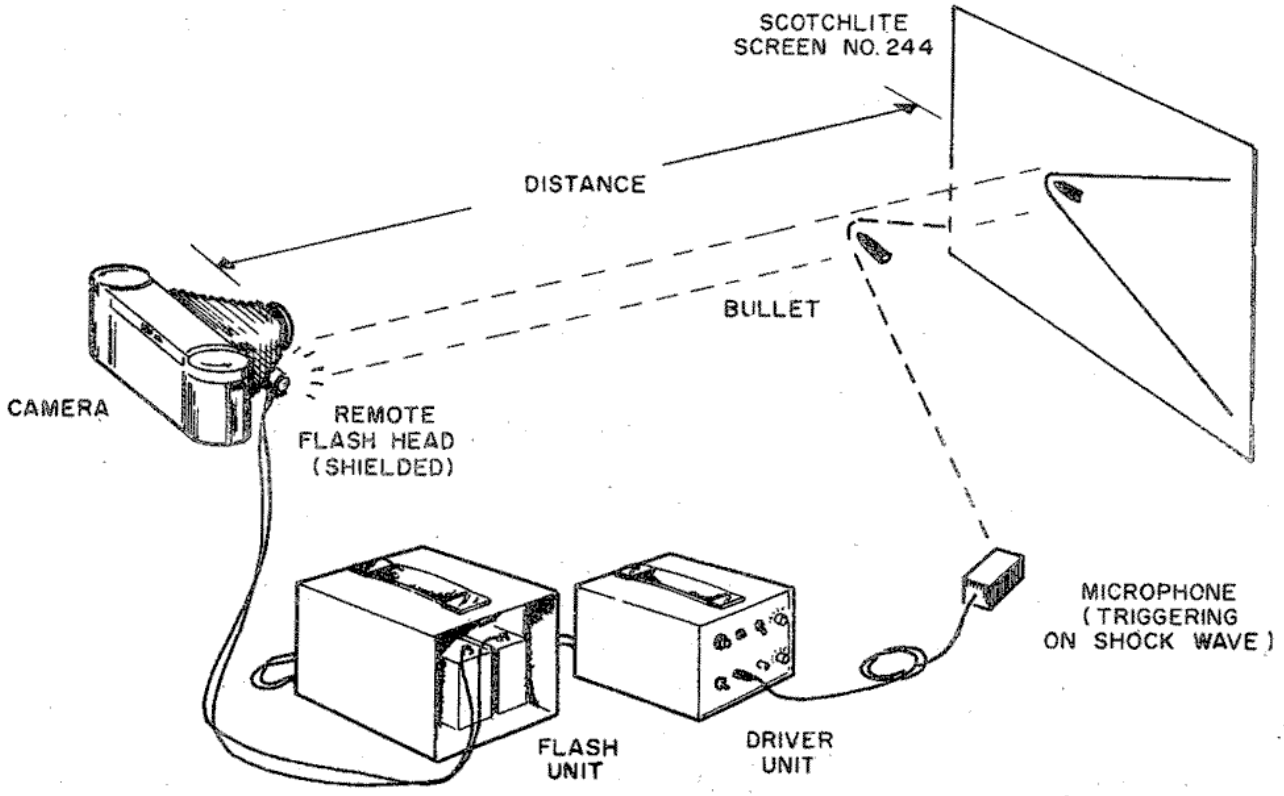
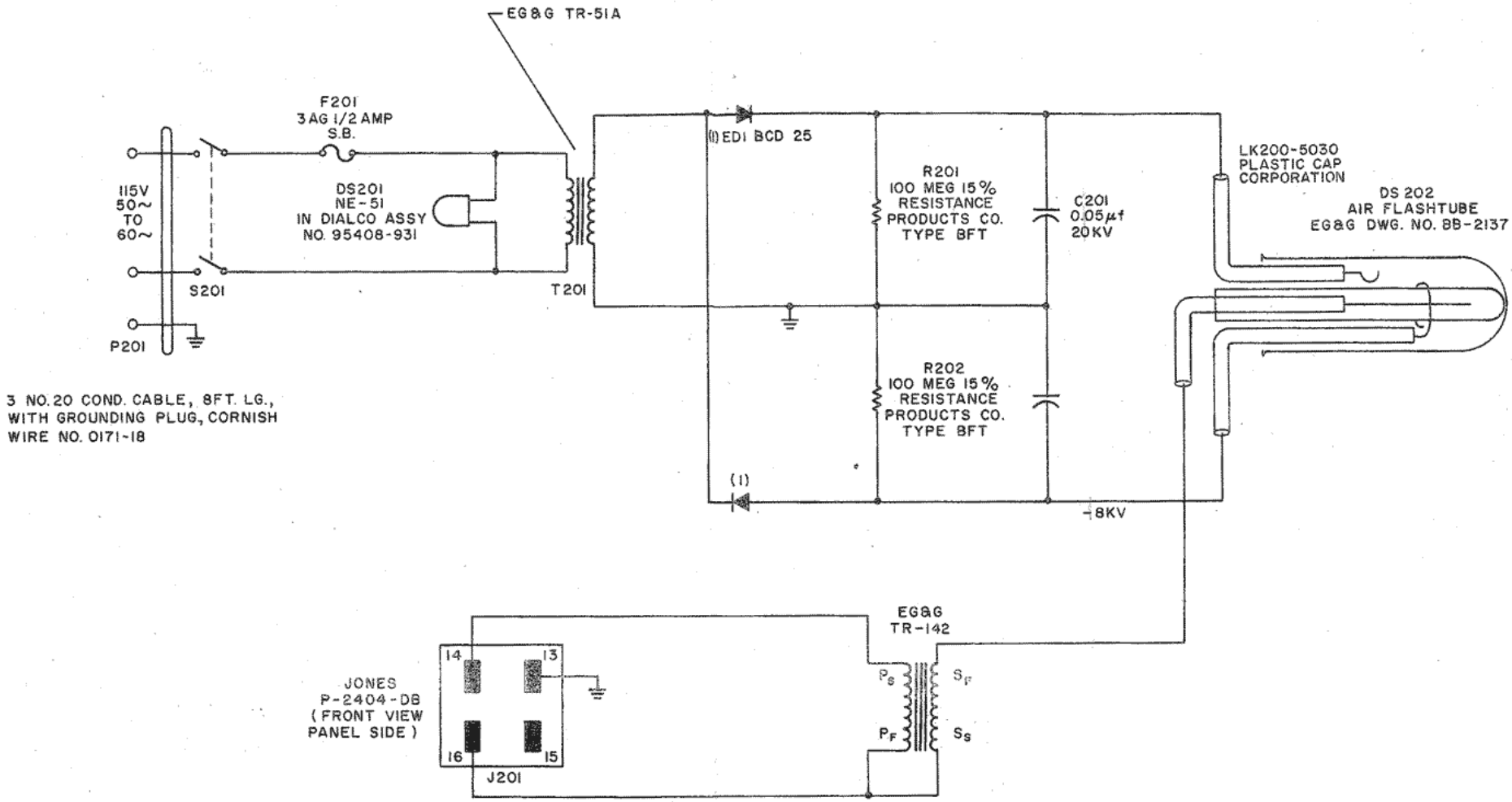


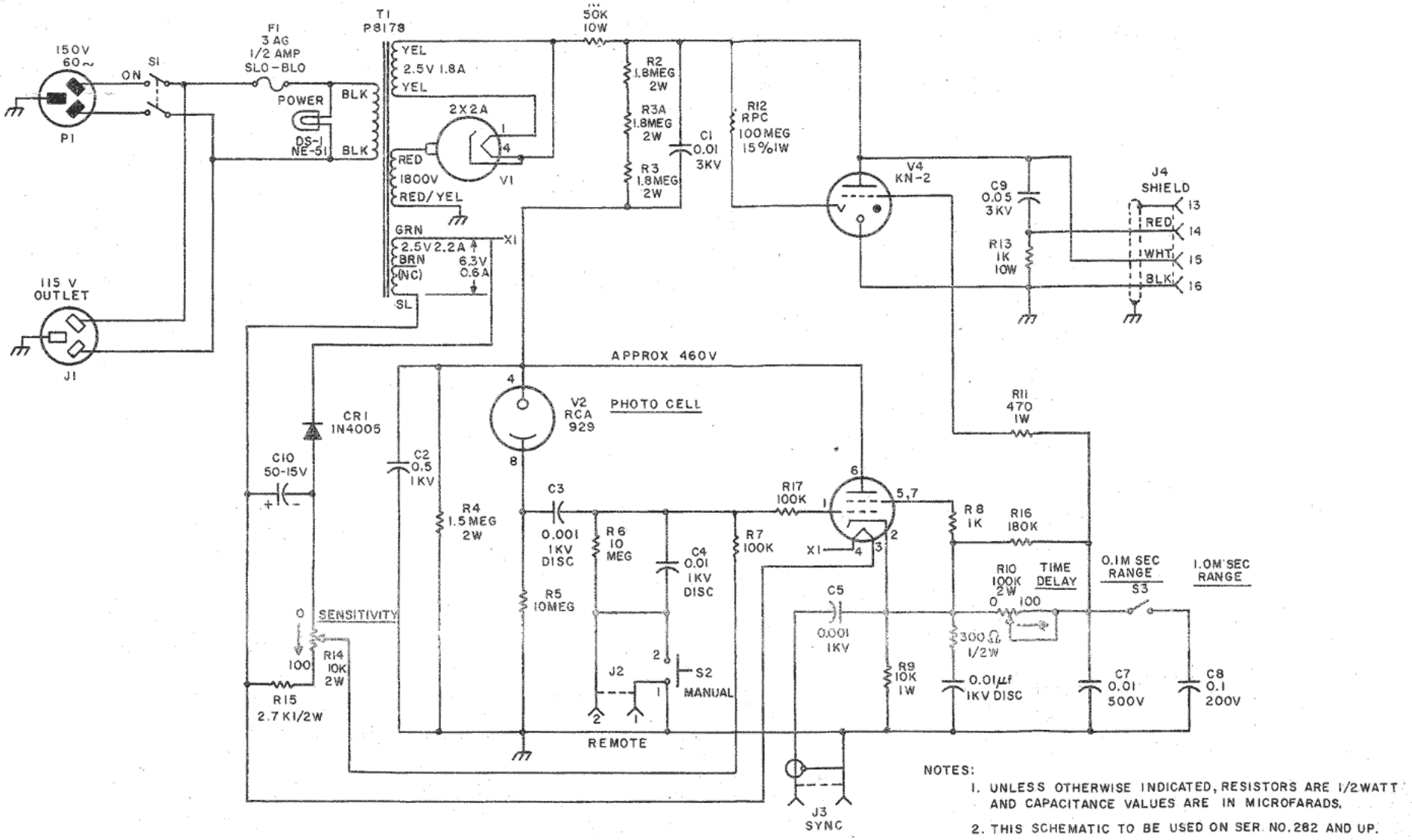
Fig. A-2. Pistol discharge photograph.



ROYAL-X PAN FILM, F-11 APERTURE, SHUTTER OPEN, CAMERA FOCUSED ON SCREEN, SUBJECT-TO-SCREEN - 10 FEET, CAMERA-TO-SCREEN - 60 FEET.

Fig. A-3. Microflash® System setup for pistol discharge photograph.


EG&G TR-51A
F201
3AG 1/2 AMP
S.B.
115V
50~
TO
60~
S201
P201
DS201
NE-51
IN DIALCO ASSY
NO. 95408-931
T201
(1) EDI BCD 25
R201
100 MEG 15%
RESISTANCE
PRODUCTS CO.
TYPE BFT
C201
0.05μf
20KV
LK200-5030
PLASTIC CAP
CORPORATION
DS 202
AIR FLASHTUBE
EG&G DWG. NO. 8B-2137
R202
100 MEG 15%
RESISTANCE
PRODUCTS CO.
TYPE BFT
(1)
-8KV
3 NO. 20 COND. CABLE, 8FT. LG.,
WITH GROUNDING PLUG, CORNISH
WIRE NO. 0171-18
EG&G
TR-142
JONES
P-2404-DB
(FRONT VIEW
PANEL SIDE)
14
13
16
15
J201
P_S
S_F
P_F
S_S



NOTES:

1. UNLESS OTHERWISE INDICATED, RESISTORS ARE 1/2WATT AND CAPACITANCE VALUES ARE IN MICROFARADS.
2. THIS SCHEMATIC TO BE USED ON SER. NO. 282 AND UP.